broad, and many of them were multiple; but those facts did not prevent us from arguing that the spectrum was chromospheric.

The lines in the present spectrum do not occupy the positions of the prominent lines in the February, 1892, spectrum, nor the positions of lines in the solar chromosphere, nor the positions of the lines in any of the bright line stars; *they do occupy the positions of the lines in the nebulæ;* the spectrum resembles nebular spectra as closely as well-known nebular spectra resemble each other: therefore the spectrum is nebular, and the fact that the lines have remained broad, or may have remained multiple, does not militate against the theory.

MT. HAMILTON, August 11, 1893.

SOLAR ECLIPSE, OCTOBER 9, 1893.

TIMES OF BEGINNING, ENDING, POSITION-ANGLES, ETC., FOR THE FOLLOWING PLACES IN THE STATE OF WASHINGTON.

	SEATTLE. Lat. 47° 35′ Long. 8h 9m 20s		CHEHALIS. Lat. 46° 40′ Long. 8h 11m 52s		SPOKANE. Lat. 47° 40′ Long. 7h 49m 40s	
	BEGINS. A. M.	ENDS. P. M	BEGINS. A. M.	ENDS. P. M.	BEGINS. A. M.	ENDS. P. M.
	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.
Pacific Standard	10 27 20	12 31 9	10 24 23	12 32 52	10 41 13	12 32 9
Local	10 18 00	12 21 49	10 12 31	12 21 00	10 51 33	12 42 29
Duration .. .	2h 3m 49s		2h 8m 29s		1h 50m 56s	
Moon's Hourly Motion in Relative Orbit...	1298.9″		1289.5″		1296.3″	
Magnitude ...	.29		.31		.22	
Position Angle.	S. of W. 3° 34′ 57″	E. of S. 4° 5′ 23″	S. of W. 1° 54′ 20″	E. of S. 5° 30′ 16″	S. of W. 10° 21′ 18″	W. of S. 0° 48′ 22″

The position angle has been located with reference to the nearest point of the quadrant on the Sun's disc, and not from the north towards the east, as is usual.

As this eclipse is annular, it is of some interest to know how much the shadow lacks of reaching the earth. I have made a computation, and have reached the following results:

Denote the Sun's parallax by ρ and the Moon's by ρ'; the Sun's semi-diameter by s, the Moon's by s'. Then the Moon's parallax at the Sun is $\frac{s\rho'}{\rho'-\rho}$; and the Sun's parallax at the Moon is $\frac{\rho s'}{\rho'-\rho}$. The semi-angle of the Moon's shadow is the difference between these values, or $16'\ 3.8''-2.35''=16'\ 1.45''$. Taking the Moon's real semi-diameter at 1081 miles, we have

$$\text{length of shadow} = \frac{1081}{\sin(16'\ 1.45'')} = 231{,}913 \text{ miles.}$$

The Moon's parallax is $55'\ 55.4''$; and with this value the Moon's distance from the Earth's center is 243,380 miles. If from this we take the length of the shadow, 231,913, we have 11,467, which is the amount which the vertex of the shadow lacks of reaching as far as the Earth's center. If from this we take the Earth's radius 3959, there is left 7508, which would be the distance in miles from the vertex of the shadow to the Earth's surface, *provided the axis of the shadow passes through the center of the Earth.* But in fact, the axis of the shadow does not pass through the Earth's center. The declinations of the Sun and Moon are both south, and the eclipse is central at apparent noon in Lat. $12°\ 27'\ 36''$ north. It follows that the axis of the shadow must strike the Earth obliquely, and as a consequence the distance from the vertex of the shadow to the Earth's surface, on the line of the axis, is somewhat increased.

If we calculate the Moon's true zenith distance, and the Moon's parallax in altitude, at the latitude $12°\ 27'\ 36''$ N. the Moon's distance from this point (where the eclipse is central at apparent noon) can be obtained by the following simple method: Denote the zenith distance by Z, the parallax in altitude by q, and the Earth's radius by R; then, sin q : sin Z :: R : Moon's distance. This gives 239,770 miles, the Moon's distance from the point where the eclipse is central at apparent noon. This, diminished by the length of the shadow gives 7857, which is the distance in miles from the vertex of the shadow to the Earth's surface on the line of the axis.

ORRIN E. HARMON.

CHEHALIS, Lewis Co., Wash.